VARIABLE STARS IN THE LARGE MAGELLANIC CLOUD.—Although the Magellanic clouds have been looked upon as centres of extraordinary physical conditions, the congregation of variable stars within their limits has hitherto remained unnoticed.

In *Circular* No. 79 of the Harvard College Observatory, however, it was announced that an examination of the Harvard photographs showed that the small cloud contained numerous variables. Consequently, an examination of the photographs of the large cloud was made, and resulted in the discovery of 152 new variable stars within its boundaries. A catalogue of these, giving their positions (for 1900·0), their magnitudes, and the magnitude-range of their light-variations, is published in No. 82 of the Harvard College Observatory *Circulars*.

All these variables have short periods, and seem to be arranged in definite groups, the most remarkable of which begins near N.G.C. 1850, and extends towards a point about one degree south of N.G.C. 2070. This group contains more than half the stars observed, and the included stars are remarkable for their faintness and for the small range of their variations.

THE SUN'S ANTI-APEX.—Mr. J. E. Gore sends the following remarks upon Prof. Kobold's study of the sun's proper motion, mentioned in last week's NATURE (p. 459):—"Prof. Kobold gives the position $A=159°{\cdot}6$, $D=-54°{\cdot}7$, or R.A. 10h. 38·4m., $\delta=-54°{\cdot}7$, and says the point is near α Argus. (His words are, 'Der berechnete Punkt liegt am Himmel ganz in der Nähe von α Argus, der gegenüberliegende Punkt in der Nähe von δ Cephei,' *Astronomische Nachrichten*, 3961.)

"This is, however, not correct, for the position of α Argus (Canopus) is R.A. 6h. 21·8m., $\delta=-52°\ 39'$ (1900). His statement that the 'opposite point' (the apex) lies near δ Cephei is, however, correct. The point found by Prof. Kobold for the anti-apex lies a little north of the famous variable star η Argus. This point lies in the Milky Way, as stated by Prof. Kobold. The fact that most of the determinations of the position of the solar apex lie in or near the Milky Way seems to suggest that the sun may be moving in an orbit 'nearly coinciding with the plane of the Milky Way.' This was pointed out by Mr. G. C. Bompas in the *Observatory*, January, 1896."

OBSERVATIONS OF THE SOLAR SURFACE, JANUARY–MARCH.—M. Guillaume, director of the Lyons Observatory, communicated a *résumé* of his observations of the solar surface during the first three months of the present year to the Paris Academy of Sciences on August 1.

The total spotted area was less than half the amount for the previous trimestre, the observed values being 2572 and 5430 millionths respectively. This was not due, however, to the absence of spots, for the phenomena have decidedly entered upon a period of increasing activity; the solar disc has not been free of spots since September 21.

In the preceding cycle the present condition of activity obtained 1·6 years after the minimum of 1889; in the present cycle 2·0 years have elapsed since that of 1901.

During the period under discussion 77 groups of faculæ with a total area of 86·0 thousandths were recorded, instead of 64 groups and 66·0 thousandths as recorded in the previous trimestre. The faculæ were also less symmetrically arranged in regard to latitude, there being 35 groups in the southern hemisphere and 42 in the northern in place of 33 and 31 respectively (*Comptes rendus*, No. 5).

INSTRUCTIONS TO VARIABLE STAR OBSERVERS.—At a meeting of the Société astronomique de France held in 1900 it was decided to form a section for the observation of visual variable stars, and for the organisation of the section a committee was formed.

This committee now publishes, in the September *Bulletin* of the society, the first chapter of a set of very detailed instructions to variable star observers.

This first instalment contains a list of stars which are especially suitable for observations of the nature proposed, minute instructions as to the methods of observing and of recording and reducing the results, and many other hints which will be found extremely useful by anyone engaged in making visual observations of variable stars.

OBSERVATIONS OF FUNDAMENTAL STARS.—In the catalogue of 2798 zodiacal stars published by Sir David Gill in 1899, 210 of the objects named were designated "fundamental stars," but the places of only about two-thirds of these were given in Newcomb's fundamental star catalogue for 1900.

To facilitate the work of other observers, Mr. R. H. Tucker, of Lick Observatory, has just published the observed places of the remaining third in No. 3965 of the *Astronomische Nachrichten*. He gives the designation, the magnitude, the observed positions (reduced to 1900), the precessional values, and, in some cases, the proper motion in each coordinate of all the stars which are given in the zodiacal catalogue but are not mentioned in Newcomb's catalogue.

THE BRITISH ASSOCIATION.

SECTION K.

SUBSECTION, AGRICULTURE.

OPENING ADDRESS BY WILLIAM SOMERVILLE, M.A., D.Sc., D.Œc., CHAIRMAN OF THE SUBSECTION.

THE audience that I have to-day the honour of addressing may be assumed to consist of a considerable proportion of the members of the British Association, and some others, who are primarily interested in, and have themselves made appreciable contributions to, the progress of Agricultural Science. I may, therefore, take the opportunity of congratulating you on this fresh evidence of progress in the subject that you have at heart, and of offering to the British Association our thanks for the encouragement and stimulus which are associated with the formation of an agricultural subsection. Perhaps I rightly interpret your feelings when I say that for the present we are satisfied with the position attained by our subject, but that we trust to see this and other meetings demonstrating that Agricultural Science is not unworthy of further advancement.

In view of the large amount of work that lies before us during the next few days, I do not propose to intervene for long between you and the contributions to original research which we have been promised. The scope of my remarks will be limited no less by time than by the fact that it would be presumptuous in me to attempt to traverse the whole field of Agricultural Science, including, as it may be held to do, the no small compartments of Horticulture and Forestry. What I propose to do, therefore, is to confine myself to touching upon a few of the subjects that have recently been receiving attention at the hands of scientific investigators, especially abroad. I have purposely avoided discussing English work, partly because it may be assumed that we are all familiar with it, and partly because, where friends are concerned, selection is difficult.

Although Agriculture has only now been elevated to a position of semi-independence in the programme of this Association, it has, in the aggregate, received much attention at the meetings inaugurated with that at York in 1831. It is interesting to turn up the early volumes of the Reports, and to ascertain what was running in the minds of our predecessors, and what the problems that they thought it vital to solve. In the account of the first meeting in this town in 1833 we find a Report by Lindley on the Philosophy of Botany, two of the items in which are of interest to students of Rural Economy. Apparently at that time much attention was being given to the mode of the formation of wood. Two theories appear to have divided botanists—the one that wood was organised in the leaves, and sent down the stem in the form of embryonic but organised fibres, to be deposited on the surface of wood already formed. The other theory was that wood was secreted *in situ* by the bark and older wood. It is to the former of these theories that Lindley gives his adherence. Although this problem has ceased to interest, the same cannot be said of another subject discussed in the same Report, namely, the so-called "fæcal excretions" of plants. In the words of Lindley, "A new apple orchard cannot be made to succeed on the site of an old apple orchard unless some years intervene between the destruction of the one and the planting of the other; in

gardens no amount of manure will enable one kind of fruit-tree to flourish on a spot from which another tree of the same species has been recently removed, and all farmers practically evince, by the rotation of their crops, their experience of the existence of the law." He attributes to Macaire the demonstration of the fact that all plants part with a fæcal matter by their roots. These excretions he held to be poisonous, maintaining that, although plants generate poisonous secretions, they cannot absorb them by their roots without death, concluding that "the necessity of the rotation of crops is more dependent upon the soil being poisoned than upon its being exhausted." He indicated the lines along which investigation might with advantage proceed, one of the questions put forward being "the degree in which such excretions are poisonous to the plants that yield them, or to others."

In 1833 botanists and agriculturists had not the advantage of the knowledge that is at our disposal through the continuous growth for a long series of years of certain crops at Rothamsted, but consideration of the fact that some crops (as, for example, pure forests of beech, silver fir, Scots pine and other trees, as also permanent pasture) may be grown for hundreds of years on the same ground without any evidence of poisoning might have led to the conclusion that the law, as it was called, was not of general application. It is, of course, true that rotations are an advantage, and it is a matter of experience that certain crops—*e.g.* clover and turnips—cannot be grown continuously on the same land, but the cause is not now associated with excretions. The reason for the failure of clover, or the cause of land becoming "clover-sick," as it is called, is still a debated point; but I may hazard the conjecture that it is due to the fact that organisms or enzymes inimical to the vital activity of the minute living bodies, that exist in symbiotic relationship with the clover plants, increase with great rapidity when the living bodies that they affect are present in abundance. Red clover is the species that is usually associated with the term clover-sickness, but it would appear that a precisely similar phenomenon is exhibited in the growth even of wild white clover. It is a matter of common observation that on certain classes of land white clover is stimulated to such vigorous growth by the use of phosphatic manures that for one year at least it monopolises the area to the almost total exclusion of other plants. But such rank luxuriance is not of long duration. In a year or two the clover disappears to a very large extent, and cannot at once be restored by any process with which we are acquainted. The land has, in fact, become sick to white clover. But given a period of rest, during which the inimical agents will disappear, and it again becomes possible to stimulate white clover to vigorous growth. We have, it seems to me, an analogous state of things in the case of certain insects. On the Continent the caterpillar of the Nun Moth (*Liparis monacha*, L.) periodically proves extremely destructive to certain conifers, and it is found that in the first year the insects are moderately abundant, in the second they are excessively abundant, while in the third the visitation begins to decline, and usually terminates quite suddenly. The causes of this cessation have been thoroughly worked out, and are found in the great increase of parasitic insects, and insecticidal fungi, including bacteria. I believe it will be found that the almost sudden cessation of our periodic visitations of the diamond-back moth is due to a similar cause.

The failure of turnips is apparently largely, if not entirely, due to the increase of insects and parasitic fungi.

The subject of harmful excretions has recently obtained renewed attention through the work being done at the Woburn Fruit Station. No point has received more striking demonstration there than the harmful influence that growing grass exerts on fruit-trees. It has been shown that this prejudicial influence is not due to the withdrawal of moisture, to the curtailment of supplies of plant food, to interference with aëration, or to modifications of temperature. In Mr. Pickering's opinion,[1] "the exclusion of all these possible explanations drives us to believe that the cause of the action of grass is due to some directly poisonous action which it exerts on the trees, possibly through the intervention of bacteria, or possibly taking place more directly." It is satisfactory to know that the subject, which is of considerable scientific and practical importance, is likely to be vigorously followed up.

In the early 'forties attention was being directed to a subject that even now has a great attraction for agriculturists, namely, the stimulating and exhausting effect of artificial manures, especially nitrate of soda. The principle that "stimuli lose their full effect upon living matter when frequently repeated" was generally held to account for the want of response that crops exhibited to repeated dressings of nitrate of soda; but Prof. Daubeny in 1841[1] pointed out what is now generally accepted as the true cause, namely, the exhaustion of the soil of other substances. This, he said, can be counteracted by giving other manures, of which he instanced bone meal. His suggestions for future investigations have been largely followed, though, as we now know, they are of theoretical rather than practical importance. He proposed the alternatives:

(1) Analysis of the soil, discovery of the amount of available plant food, and the application of the substances found to be deficient up to the probable measure of the crop's requirements.

(2) Discovery, by analysis of the yield, or estimation by calculation, of the amount of plant food removed in the produce, and the application to the soil in the form of manure of what was withdrawn by the crop.

Daubeny suggested that manuring should be undertaken on a system of book-keeping—on the one side being entered all the items of plant food taken out by crops, and on the other all that is applied in the form of manures, the two sides of the account being made to balance. This theory of manuring is distinctly suggestive, and often fits in rather remarkably with actual practice, though the comparative agreement between theory and practice is due to causes that the author of the theory probably hardly contemplated. Take, for instance, the case of wheat. An average crop removes from an acre about 50 lbs. nitrogen, 30 lbs. potash, and 20 lbs. phosphoric acid. This loss would be restored by the use of some 3 cwt. nitrate of soda, 2 cwt. kainit, and $1\frac{1}{2}$ cwt. superphosphate; and on many soils wheat could, no doubt, be grown continuously for many years on such a mixture, aided by good tillage, without the yield suffering materially. But we now know that much of the plant food offered in manure never enters the crop at all, so that the balancing of the account is due almost as much to chance as to calculation. This becomes more apparent when we regard such a crop as meadow hay, which in actual practice is often grown for a long series of years on the same land. To balance the withdrawal of phosphoric acid by an average yield of this crop only about $\frac{3}{4}$ cwt. of superphosphate per acre is theoretically necessary, but on most soils an average yield would not be maintained by the use of so small a quantity.

During the 'fifties the volumes of the Association contain several important contributions from the two distinguished Englishmen to whom the world's agriculture owes so much, Lawes and Gilbert. Their first contribution was made in 1851, and dealt with Liebig's mineral theory, a subject with which their names will always be associated. They drew upon their rich store of experimental data to prove that the yield of wheat is much more influenced by ammonia than by minerals, and they gave it as their deliberate opinion that the analysis of the crop is no direct guide whatever as to the nature of the manure required to be provided in the ordinary course of agriculture. With the reservation "in the ordinary course of agriculture," the dictum cannot be questioned, though in the circumstances of the continuous growth of wheat, as has been pointed out, conclusions indicated by the analysis of a crop happen to accord, at least approximately, with manurial practice.

Field experiments or demonstrations, which have been such a prominent feature of the educational work of the past decade, appear to have been first introduced at the meeting of the Association in 1861 by Dr. Voelcker.

While agricultural subjects have claimed a considerable share of the time of the Association, forestry has not been altogether overlooked. As early as 1838 we find attention being directed to what has of recent years come to be a burning question—namely, the maintenance of our timber supplies. At that early date, when the industrial develop-

[1] "The Effects of Grass on Apple Trees." *Journal R.A.S.E.* Vol. lxiv. p. 365.

[1] "On Manures considered as Stimuli to Vegetation."

ment of the country was, comparatively speaking, in its infancy, the estimate of our timber requirements was, in the light of present experience, amusing in its modesty. Captain Cook estimated that "100,000 acres of waste taken from the Grampian Hills for the growth of larch would in two generations not only supply the ordinary wants of the country, but enable us to export timber."[1] Assuming a rotation of eighty years, this estimate postulates that the produce of some 1200 acres, of a value of about 120,000*l.*, was sufficient to make us independent of foreign supplies. Such is the estimate of 1838; now let us turn to the estimate of 1904. Dr. Schlich, in his volume on "Forestry in the United Kingdom,"[2] passes in review Britain's timber requirements, and, after making allowance for woods like mahogany, teak, &c., which cannot be grown here, he comes to the conclusion that "if all these items are added up we find that we now pay for imports in timber . . . the sum of 27,000,000*l.*, all of which could be produced in this country." Assuming as before that the value of an acre of mature forest is 100*l.*, it means that our imports are drawn from 270,000 acres, and to maintain our supplies merely at their present level a forest area of more than 20,000,000 acres, worked on an eighty years' rotation, is necessary.

Although it has been reserved for the Cambridge Meeting of 1904 to witness the delivery of an Address from the Chair of an Agricultural Subsection, this is by no means the first occasion on which an agricultural subject has furnished the theme for a Presidential Address. In 1880 the then Dr. Gilbert presided over Section B, and chose for his subject Agricultural Chemistry; in 1894 Prof. Bayley Balfour inaugurated the work of the Biological Section with an Address on Forestry; while in 1898 the President of the Association focussed the vision of all thinking men on the greatest agricultural problem of all—the World's Supply of Wheat.

German Investigations on the Action of Conservation Agents on Farmyard Manure.

Those who have followed the progress of Agricultural Science in Germany must have noticed how much attention has been given during the past ten years to investigating the changes that take place in farmyard manure during storage under varying conditions. The stimulus and funds for this work have for the most part been supplied by the German Agricultural Society, which in 1892 resolved to carry through an exhaustive inquiry. For this purpose it enlisted the cooperation of several of the most fully equipped stations in the Empire, and the reports that have appeared bear testimony to the industry and analytical ingenuity that have been brought to bear on this important subject.

The experiments were originally designed to extend over four years, the first, 1892–3, being devoted to preliminary, chiefly laboratory, experiments; the others, to work on a scale more in accordance with farm practice. But although the period originally contemplated is now long past, the problem is by no means solved, and the Society has recently been making a fresh grant for additional experiments of a similar character. In point of fact, the subject has been found to bristle with difficulties, and the results obtained with small quantities of manure, or in summer, have not always been confirmed with large quantities of manure, or in winter.

In 1897 I published an account[3] of the more important results obtained up to that time, confining myself chiefly to questions of temperature and the loss of organic matter, and the conclusion arrived at was that "none of the conservation agents usually employed appears to have any very important influence on the decomposition of farmyard manure."

Since then several important reports[4] have appeared, and I propose shortly to refer to their contents.

[1] Cook, "On the Genera Pinus and Abies."
[2] Bradbury, Agnew and Co., 1904.
[3] *Journal Board of Agriculture*, September, 1897.
[4] Hansen and Günther, "Versuche über Stallmist-Behandlung," *Arbeiten der Deut. Land. Gesell.* Heft 30, 1898. Pfeiffer, "Stallmist-Konservirung," *Ibid.* Heft 73, 1902. Immendorff, "Ueber Stallmist-Bewahrung," *Mitt. der Deut. Land. Gesell.* Heft 21, 1903. Schneidewind, "Fünfter Bericht über die Versuchswirtschaft," *Lauchstädt, Land. Jahrb.* xxxiii. p. 190.

While the experiments have in almost all cases dealt with the fate of nitrogen, phosphoric acid, and potash, the chief interest centres round the nitrogen, for, given reasonably satisfactory conditions of storage, it is only this constituent of farmyard manure that is likely to suffer loss. But much importance, from the experimental point of view, attaches to the analytical results obtained with the other two substances, for the reason that the quantities of these found are the surest test of the accuracy of the work. The general method of procedure has been to employ a fairly simple but sufficiently nutritious food-mixture, and to allow a definite quantity of this and of litter for a certain number of selected cows. The weight of nitrogen, phosphoric acid, and potash in the food is accurately determined, all of which ultimately reaches the manure, less what goes into the milk, and into the live-weight increase, if any. If the account of what the animals receive as food and litter, and what they furnish as liquid and solid fæces, milk, and animal increase, approximately balances as regards mineral matter, it may be assumed that the sampling and analysis have been sufficiently accurate to justify definite conclusions being based on any deficiency in nitrogen that may be found.

The work of Hansen and Günther, Pfeiffer, and Immendorff was carried out at consecutive periods from 1893 to 1902, at the experimental station of Zwätzen, near Jena, where stalls and dung-pits had been constructed for the purposes of this research. Schneidewind's experiments were conducted at the station of Lauchstädt, near Halle.

Effects of Kainit.—This was used by Hansen and Günther at the rate of 0·75 kg. per 1000 kg. live weight of stock per day, while Pfeiffer and Immendorff used twice as much. The kainit was in no case spread on the litter in the stall, as this would have caused inflammation of the skin of the udder, legs, and abdomen of the cows, but was sprinkled on the manure as spread and pressed into the pits. In certain series of the experiments the manure was removed from the stalls daily, in others it was only removed once a week. Two weeks was the usual time necessary to collect a sufficient quantity of manure, which, with the liquids, usually amounted to about 8000 kg. at Zwätzen, and about one-fifth of this weight at Lauchstädt. The period of storage was generally about four months.

Hansen and Günther found that in pits the untreated manure lost 11·5 per cent. of nitrogen; while the manure treated with kainit lost 14·4 per cent.

Pfeiffer found that the loss of nitrogen in untreated manure was 17·2 per cent., which compares with a loss of 19·5 per cent. in the presence of kainit. The loss of nitrogen when kainit was used by Immendorff was 21·3 per cent., the loss in the untreated manure not being given in his tentative report so far available. Schneidewind did not experiment with kainit. The results of these experiments are in complete relative agreement, and show that the loss of nitrogen is greater when kainit is used than when it is withheld.

Effects of Superphosphate.—This substance was spread twice daily over the litter in the stall at the rate of 0·75 kg. per 1000 kg. live weight. The results obtained were as follows:—

—	% Loss of Total Nitrogen	
	In untreated dung	When super. used
Hansen and Günther ...	10·25	16·25
Pfeiffer	17·20	20·80
Immendorff	—	19·80

With superphosphate, as with kainit, the loss of nitrogen during the storage of dung has been increased. It may, however, be mentioned that Hansen and Günther and Immendorff found that superphosphate conserved nitrogen to an appreciable extent so long as the dung lay in the stall, but that its effects disappeared whenever its acid phosphate and free sulphuric acid had been neutralised by ammonia, and this rapidly occurred in the pit.

Effects of Precipitated Phosphatic Gypsum.—This at the

rate of 1 kg. per 1000 kg. live weight was tried by Hansen and Günther and Immendorff, the substance employed containing fully 8 per cent. P_2O_5. It was spread twice daily on the litter in the stall. The result obtained by Hansen and Günther was that after lying for seventeen weeks in the pits the manure that had been untreated had lost 10·35 per cent. of nitrogen, whereas that treated with the phosphatic gypsum showed a loss of 14·47 per cent. The loss of nitrogen found by Immendorff when this substance was used amounted to 19·8 per cent. This substance, like the others, would therefore appear to be valueless as a fixer of nitrogen.

Effects of Gypsum.—This substance has long been recommended as an agent for conserving nitrogen in the dung-heap. The results of its use, spread twice daily on the litter in the stall at the rate of 1 kg. per 1000 kg., live weight, in the experiments conducted by Hansen and Günther, were that in the presence of gypsum the loss of nitrogen amounted to 11·89 per cent., which compares with a loss of 8·56 per cent. when nothing was mixed with the dung.

Schneidewind, using a much larger quantity of gypsum, namely, 5 lbs. per 100 lbs. of dung, found that the loss of nitrogen was reduced from 35·69 per cent. to 15·22 per cent. In this connection he says: "The use of gypsum has markedly reduced the loss of nitrogen. Assuming the conserved nitrogen to have a good action on the crop, this agent may be said to have paid. But as the bulk of the nitrogen so conserved was found to consist of slow-acting albuminoid compounds, and seeing that the sulphate of lime was largely reduced to sulphides, which are directly injurious to plants, we cannot conclude that the use of gypsum has been profitable. Investigations with this substance will, however, be continued."

Hansen and Günther carried their experiments the length of using the various lots of manure on crops, but this part of their researches was hardly more favourable to the use of conservation agents than the other. They thus express themselves: "When the various manures were used on crops, five times in six the treated manure acted no better than the untreated. Only on one occasion was an improvement observable. Field and pit experiments alike have proved that the conservation agents employed are of no value." Schneidewind expresses himself equally forcibly when he says: "As the result of many experiments conducted by ourselves and others, we have arrived at the conclusion that chemical substances are valueless as conserving agents."

Pfeiffer also tried sulphuric acid sprinkled over the manure as it was placed daily in the pit, when it was found that the loss of nitrogen was reduced from 27·8 per cent. to 7·1 per cent. In this connection Pfeiffer says: "The cost, however, was nearly a mark for each kilo. of nitrogen conserved, and the use of sulphuric acid is associated with so many drawbacks that its employment cannot be recommended."

Schneidewind came to a similar conclusion, and thus expresses himself: "As a result of numerous conservation experiments carried out with various quantities of sulphuric acid, and with various acid sulphates, we cannot advise the use of these substances."

But although no benefits have been obtained from the use of the substances indicated, some useful information is available as to the advantages of giving attention in other directions to the management of farmyard manure. Hansen and Günther took four lots of manure of similar character, storing two of the lots in pits and placing the other two in heaps in the open field. From the end of September until the middle of December the pitted material had on the average parted with 13·25 per cent. of total nitrogen, whereas the loss in the manure in heaps averaged 25·3 per cent. When the behaviour of the ammoniacal nitrogen was investigated it was found that the loss was 35·73 per cent. in the pits and 82·5 per cent. in the heaps. The loss, therefore, is greatest in that part of the nitrogen which is the most active and the most valuable.

In another series of experiments by the same investigators the manure was all placed in pits, but in one case it was spread equally and trodden down, while the escape of liquids was prevented. In the other case the manure was simply thrown loosely and irregularly into the pit without spreading or treading, the surface being left uneven and therefore much exposed to the air, while the liquids were allowed to drain away. After lying for twenty-two weeks the loss of nitrogen was 15·76 per cent. in the pit containing the carefully treated manure, whereas in the other pit the loss amounted to 34·58 per cent.

Pfeiffer in a series of experiments proved that much of the nitrogen that disappears from manure is lost before the manure is transferred from the stall to the dungstead. He is strongly of opinion that stalls, boxes, and the like, should either be cleaned out twice daily, or, if the construction admits, the manure should be left to accumulate until it is some feet in depth, as in the system of management that prevails in cattle-courts and yards in this country.

The general conclusion arrived at, and clearly expressed by Pfeiffer, is that excessive loss in manure can be best avoided by storing it in a deep mass in a water-tight dungstead placed in a well-shaded situation, in which the material is firmly compressed. The necessary compression can be secured in various ways, perhaps most conveniently and effectively by means of the treading of cattle. The use of a considerable proportion of moss-litter is strongly recommended. This substance not only absorbs and retains the liquids, but, being acid, it fixes ammonia. In the absence of moss-litter, loamy soil rich in humus will prove a useful substitute.

The Chemical Fixation of Atmospheric Nitrogen.

It has for long been the dream of chemists to discover, or welcome the discovery of, a chemical process, capable of industrial application, by which the nitrogen of the air could be made available to replace or to supplement our rather limited supplies of nitrogenous manures. In his Presidential Address, Sir William Crookes had something to say on this fascinating subject, and looked hopefully to electricity to solve the problem. He pointed out that with current costing one-third of a penny per Board of Trade unit a ton of nitrate of soda could be produced for 26*l.*; while at a cost of one-seventeenth of a penny per unit—a rate possible when large natural sources of power, like Niagara, are available—the cost of such artificial nitrate of soda need not be more than 5*l.* per ton.[1]

Dr. von Lepel, in giving an account of recent work on this subject to the winter meeting of the German Agricultural Society in February of this year,[2] puts the cost of electric nitrate, as compared with Chili nitrate, in the proportion of 24 to 39, which is in close agreement with Sir William Crookes's estimate. Lepel points out that the material obtained, neutralised by some alkali, consists of a mixture of nitrate and nitrite. When used in pot-culture experiments it has given results closely agreeing with those furnished by Chili nitrate.

Good progress would also appear to have been made in another direction in the commercial fixation of atmospheric nitrogen, and a short account of the results was communicated by Prof. Gerlach, of Posen, to the meeting of the German Agricultural Society already referred to, and is published in the same issue of the *Mittheilungen*.

When air which has been freed of oxygen is conducted through finely disintegrated calcium carbide at a high temperature, one atom of carbon is displaced by two atoms of nitrogen, and calcium cyanamide ($CaCN_2$) is formed. This substance is also produced when a mixture of lime or chalk and charcoal is heated to a temperature of 2000° C. in a current of air.[3] When pure, this substance holds 35 per cent. of nitrogen, but in its crude commercial form it contains only about 20 per cent. Treated with acids, calcium cyanamide is changed into dicyandiamide, a substance holding nearly 67 per cent. of nitrogen, but directly poisonous to plants. Or, if heated in superheated steam, calcium cyanamide parts with all its nitrogen as ammonia, which, of course, is easily brought into a portable form.

But experiments conducted at Posen and Darmstadt during the past three years, both in pots and in the open field, have shown that calcium cyanamide itself is a useful nitrogenous manure, field experiments giving results about 20 per cent. below those obtained by the use of an equal amount of nitrogen in the form of sulphate of ammonia.

[1] Crookes, "The Wheat Problem," p. 47.

[2] Dr. von Lepel, "Neuere Versuche zur Nutzbarmachung des atmosphärischen Stickstoffs durch Elektrische Flammenbogen," *Mitteil. d. Deut. Land. Gesell.*, 1904, Stuck 8.

[3] Bull, *Imp. Inst.* June 30, 1904.

In prepared soil in pots the results fully surpassed those obtained both with nitrate of soda and sulphate of ammonia, the less satisfactory yields obtained in the field being perhaps due to the organic acids inducing the formation of a certain amount of the poisonous dicyandiamide.

So far as one may judge from the information available, it would appear that agriculture will not have long to wait until it is placed in the possession of new supplies of that most powerful agent of production, nitrogen, and Sir William Crookes will see the fulfilment of his prediction that "the future can take care of itself."

Nitragin.

A few years ago much interest was excited in this and other countries by the announcement that the scientific discoveries of Hellriegel and Wilfarth had received commercial application, and that the organisms of the nodules of the roots of Leguminosæ could be purchased in a form convenient for artificial inoculation. The specific cultures placed upon the market were largely tested practically and experimentally, but the results were such as to convince even the patentees, Nobbe and Hiltner, that the problem which promised so much for agriculture had not been satisfactorily solved. Since that time, however, investigators have not been idle, and the present position of the subject is to be found in a recent Report by Hiltner and Störmer.[1]

It was early recognised that the organisms (bacteria) which inhabited the root-nodules of the various species of Leguminosæ were not all alike, and that, in fact, they showed marked physiological if not morphological distinctions. Any particular species of leguminous plant is found to resist more or less successfully the attempt of these various organisms to effect an entrance into its root-hairs, and according to the power of the organism to gain access, and to establish colonies, so is the particular plant benefited and the stock of fixed nitrogen increased. This power of adaptability of the organism is designated its "virulence," a term, however, which is perhaps hardly suited to our English mode of expression, though it may for the present be retained. It has been found that organisms of what is called "high virulence" are capable of entering with ease the root-hairs of vigorous plants at an early stage of their growth, and of inducing the formation of nodules that are large, numerous, and placed high up on the roots. Organisms of low virulence, on the other hand, can only enter plants of feebler growth, or plants that have passed the most vigorous stage of youth, so that the nodules, in this case, are small and scarce, and distributed, for the most part, near the ends of the roots. The practical object, therefore, would appear to be the breeding of strains or varieties of organisms of high virulence, adapted to the symbiotic requirements of the various important species of farm and garden leguminous crops.

The nitragin put on the market a few years ago was used in two ways, being either applied directly to the fields, or mixed with water and brought into contact with the seed before sowing. Under the former method of procedure an increase of crop was obtained only when the nitragin was used on land containing much humus. The explanation given for failure under other conditions was that the bacteria artificially introduced perished for want of food before the leguminous seed germinated and produced plants.

Failure of the nitragin to effect an improvement in the crop when it was sprinkled on the seed is now believed to be due to the action of secretions produced by the seed in the early stages of germination. These secretions are found to be rich in salts of potash, and when brought into contact with the bacteria in question they induce changes allied to plasmolysis, and these changes are subsequently followed by death. This difficulty was found to be got over by moistening the seed and allowing it to sprout before the nitragin was applied; but manifestly such a procedure would always be difficult, and often impossible, to carry out in practice. The object, however, would appear to have been gained in another way, namely, by cultivating the bacteria in a medium that imparts to them the necessary power of resistance. Such nourishment may take various forms, but that which gave the best results consisted of a mixture of skim milk, grape sugar and pepton, and it is in this medium that the organisms of the nitragin now distributed are cultivated.

Early in the present year the new nitragin was being offered free of cost to all members of the German Agricultural Society on the condition that it was used in accordance with the directions that accompany it. In consequence of the large demand the free offer was in April withdrawn, but the substance may be purchased from Prof. Hiltner, of Munich, in quantities sufficient to treat the seed of a half to one acre at the price of one shilling. The United States Department of Agriculture are so convinced of the practical utility of the improved nitragin that they are distributing large quantities to American farmers. In this way the material will be thoroughly tried in two hemispheres under practical conditions, and abundant evidence should soon be forthcoming as regards its effects. It is to be hoped that British investigators will not be deterred by past disappointments from putting the new form of nitragin to the test.

Improvement of Varieties of Crops.

Speaking generally, the attention of agricultural investigators during the past fifty years has been directed more to manurial and similar problems than to the improvement of the yield of crops through the agency of superior varieties. This, it seems to me, is the outcome of the tradition that agricultural science is based upon chemistry, using the term in its old-fashioned and restricted sense, and as a consequence farmers have looked principally to the chemical laboratory for light and leading. It is true that much excellent work has been accomplished from the botanical side, but this has been performed rather by farmers, seedsmen, or amateurs, than by trained botanists. But fortunately the botanist is now getting his opportunity, and the possibilities before him are sufficiently attractive.

Judging by the results that have been obtained, it would appear that wide divergences as regards yield, nutritive qualities, resistance to disease, and other important properties exist between varieties of the same plant-species; so much so, in fact, is this the case that attention to the relationship between variety and locality would appear to be one of the most important matters to which a farmer can give consideration. But it has been found that new varieties are frequently unstable, reverting rather rapidly to an unsatisfactory form, or displaying a lack of power of resistance to disease. It therefore becomes necessary constantly to be producing new varieties to take the place of those that are worn out, and it seems reasonable to anticipate that the professional botanist will take a much larger part in this work than has been the case in the past.

Not only is the yield of a crop greatly influenced as regards quantity and quality by the variety of seed employed, but, as is well known to practical farmers, the local origin of the same variety of seed has a marked influence on many properties of plants (vigour, resistance to disease, and resistance to frost, and to weather generally), and these properties quickly react on the yield. In this country we have a prejudice in favour of the seed of English-grown red clover, Provence Lucerne, Scotch potatoes, Belgian flax, Ayrshire ryegrass, pine and larch from Scotland, Norfolk and Cambridge barley, Warp-land wheat, &c., and there seems no reason to doubt that such preferences are based upon sound experience. This subject would appear to be one that is still full of interesting and important possibilities, and last year I had the opportunity of seeing some striking results in a new and unexpected direction. During the past few years the Austrian Experimental Forestry Station of Mariabrunn has given much attention to the influence of the local origin of the seed on the resulting trees, especially the common spruce, and, although it is too early to pronounce a final judgment on the results, these are already so conspicuous as to warrant my placing some figures before you.[1]

In the autumn of 1896 a supply of seed was obtained from certain definite localities, the trees that yielded it being of varying dimensions and situated at various altitudes. The seed was sown in the spring of 1897 in the nursery attached to the station, and, having been transplanted into lines, a portion of the young trees are growing there now. Others

[1] "Bericht über neue Untersuchungen über die Wurzelknöllchen der Leguminosen und deren Erreger," *Arbeiten aus der Biol. Abteil. für Land- und Forstwirtschaft am K. Gesundheitsamte*, Band iii. Heft 3.

[1] "Programm der vierte Versammlung des Internat. Verbandes Forstlicher Versuchsanstalten zu Mariabrunn," 1903, p. 47.

were, in 1899, planted out in a wood (Loimannshagen) in the neighbourhood. In the autumn of 1902 the young trees were carefully measured, with the following results :—

Locality of Origin of the Seed	Height above Sea-level of the Mother-tree	Average Annual Height-growth of the Mother-tree	Average Height (1902) of the Young Trees		Average Growth in Height of the Nursery Trees in 1902
			In the Wood	In the Nursery	
	metres	cm.	cm.	cm.	cm.
Piesendorf, Salzburg ...	1400	24	62	85·2	34·7
,, ,, ...	1750	14	47	61·6	23·3
St Andrä in Kärnten ...	1420	25	57	71·1	27·1
,, ,, ...	1625	18	41	51·2	18·4
,, ,, ...	1650	15	35	39·1	14·2
Treibach, Kärnten ...	900	28	56	81·6	30·7
,, ,, ...	900	29	53	80·9	29·7
Achenthal in N. Tyrol...	900	31	64	87·9	29·0
,, ,, ...	1300	28	67	80·5	27·9
,, ,, ...	1600	26	50	62·2	21·8

These figures show—

(1) That where, in any particular locality, mature trees were measured at different elevations, the tallest trees, as was to be expected, were found at the lowest elevation.

(2) That where the seed of such trees was sown the height of the resulting trees, at the age of six years, was in close relationship to that of the mother trees.

(3) That where mother trees of approximately equal height from the same locality and the same elevation (Treibach) were selected, the resulting progeny were also of approximately equal vigour.

The differences in the height-growth of the young trees are so striking as to lead to the conclusion that the financial returns of Forestry operations may be profoundly modified by the origin of the seed, and it would apparently pay nurserymen and planters well to give their careful attention to this subject.

Joint or Cooperative Work.

In conclusion, I may be allowed to direct your attention to a prominent feature of experimental or demonstrational work which is found to exhibit itself in all countries of the world where serious attention is given to the improvement of agricultural production. While, no doubt, it is the individual who plants the germ of a new idea and fosters its growth until it is fairly established, it is by systematised cooperative effort that the practical value of the idea is tested, and that the knowledge is made available and acceptable to the workaday farmer. Various objections have been urged against field experiments, and it need not be denied that they are incapable of supplying a satisfactory answer to many scientific questions. Such experiments are exposed in no small degree to the disturbing influences of inequalities of soil, irregular cultivation, the attack of animals, and the vicissitudes of climate; but when reasonable precautions are taken to guard against these, and given a sufficient number of tests, the results of field trials are of the highest value as a guide to practice. Apart from attention to the preliminary details of the scheme, and to care in carrying it out, the main point to aim at in field-trials is to have them so frequently duplicated or repeated that the disturbing factors inseparable from field-work will be largely eliminated. Such duplication may take the form of repetition of the same test on the same area year after year, when one obtains some such series of results as those that have helped to make the reputation of Rothamsted. But however convincing may be the results of a series of experiments that have marched majestically on for half a century, they lack attractiveness for the investigator who desires to solve not one but many problems during his lifetime. For him, therefore, duplication in time gives place to duplication in space—in other words, he secures the same end, or an end that is in many respects equivalent, by repeating the test at several places in the same season, or in a short series of seasons. This method of work is, of course, by no means new. It was utilised with great advantage by the late Dr. Voelcker, and by our more recently departed friend Dr. Aitken, and it is a line that is still being followed by the two great societies with which these distinguished workers were so long associated. The method is also being practised extensively, chiefly through the agency of societies, in Germany, France, and other European countries, and it has taken firm hold in the United States and in some of our colonies. One of the largest and most successful agencies in cooperative demonstrations is to be found in Canada, where, during the past nine years, an average of 37,000 farmers have annually received small parcels of improved seeds through the Government experimental organisation directed by Dr. Saunders. It is claimed that the financial results to the country as a whole run to many millions of dollars, and there seems to be no reasonable doubt as to the accuracy of the statement.

I trust you will pardon my referring in this connection to a matter that is personal to a considerable proportion of this audience, and of saying that, in my opinion, one of the best pieces of work that has been done in this country in recent years is the preparation of the scheme of joint experiments by the Agricultural Education Association. The problems set for solution under that scheme are of the simple, direct, practical kind that field-work is thoroughly qualified to deal with. But the essence of success lies in the power of numbers, and the control of this factor rests with the members of the Association themselves. Now, most of the members of that Association are not only investigators but also teachers, and many of the institutions that they represent have recognised the advantages of keeping in touch with their past pupils through the agency of collegiate Associations. These old students, it seems to me, represent a large mass of most valuable material for carrying through cooperative experimental work of the class referred to, and I am convinced that the agriculture of the country would benefit in no small degree were this powerful agency fully utilised.

SECTION L.

EDUCATIONAL SCIENCE.

OPENING ADDRESS BY THE RIGHT REV. THE LORD BISHOP OF HEREFORD, D.D., LL.D., PRESIDENT OF THE SECTION.

I AM moved to begin this address with a word of personal apology, the strongest feeling in my mind, as I rise to deliver it, being that in the fitness of things some one of the many distinguished representatives of education in this University would have been the natural occupant of this chair on the present occasion; and for my own part I could hardly have brought myself to accept the invitation with which I have been honoured had I not been led to understand that on occasions of this kind it is preferred by the members of the University visited that some one from the outside should be invited as I have been.

Thus I have accepted, not without hesitation and misgiving, but with the more gratitude, as feeling that I am here because of the wish of the Cambridge authorities to have someone connected with the University of Oxford, and I desire that the grateful acknowledgment of this courtesy and kindness should be my first word as President of the Educational Section.

The inclusion of Education among the various sections of this Association for the Advancement of Science is sufficient evidence that a new educational era has begun in this country.

Whatever may be the defects of our educational system or want of system, whatever changes may be necessary to bring it, in the current phrase, up to date, the days of unthinking tradition are over.

Scientific method is entering on its inheritance, and it has begun to include the field of education along with other fields of life and thought within the sphere of its influence.

And scientific minds are asking on every side of us what is the end of true education, and are we on the right way to it?

True education, almost insuperably difficult in practice, has been often defined in words.

Plato told us long ago how it is music for the soul and gymnastic for the body, both intended for the benefit of the soul, how it is a life-long process, how good manners are a branch of it and poetry its principal part, though the

poets are but poor educators, how great is the importance of good surroundings, how the young should be reared in wholesome pastures and be late learners of evil, if they must learn it at all, how nothing mean or vile should meet the eye or strike the ear of the young, how in infancy education should be through pleasurable interest, how dangerous it is when ill directed, how it is not so much a process of acquisition as the use of powers already existing in us, not the filling of a vessel, but turning the eye of the soul towards the light, how it aims at ideals and is intended to promote virtue, and is the first and fairest of all things.

In this description, I take it, we most of us agree, though some of Plato's views would doubtless elicit differences of opinion amongst us, as, for instance, that education ought not to be compulsory, or that it should be the same for women as for men.

One of his statements may be soothing to our English self-complacency, for as is the habit of idealists in every age, he says that even in Athens they care nothing for educational training, one of the most brilliant of their younger statesmen pleading that it does not matter, because others are as ignorant as he.

Or again, our own Milton sums it up in fewer words, but very impressively, when he says true education fits a man to perform justly, skilfully, and magnanimously all the offices, both private and public, of peace and war.

It is a noble aim which he thus sets before us, to make our sons skilful, just, magnanimous, and every description of aims and methods can be little more than an expansion of it.

Of the importance of right aims and ideals there can, as Plato reminded us, be no question, because of the danger of ill-directed aims, and the lasting nature of early impressions.

What we learnt at school, when all the world was young to us, whether we learnt it with weariness or pain, or under happier influences with a quickening pulse and the glow of enjoyment, passed into the blood, as Stevenson said somewhere, and became native in the memory.

True education, then, as we all acknowledge, aims at cultivating the highest and most efficient type of personality, men not only appropriately and technically equipped for their professional business, but men endowed with the best gifts and inspired with high purposes, men who desire to follow the more excellent ways and to lead others in them, who love knowledge, truth, freedom, justice, in all the relations of life, whether individual or social, men marked by sense of duty and moral thoughtfulness, public spirit, and strength of character.

Such an education is the true basis of individual and national welfare, and experience has abundantly shown how necessary this is to save men from distorted views of history, from wrong conceptions of patriotism and public duty, from mistaken aims and disastrous policy.

Thus, for instance, a good and true education shows us that the true basis of life is moral and economic and not military, and the true aim of both individuals and nations is knowledge, justice, freedom, peace, magnanimity, and not pride, aggression, force, or greed.

Scientific consideration of our subject will of course deal largely with such details as the relative claims of the humanist and the realist, subjects and methods of instruction, the correlation of different grades of education, the adaptation of this or that system to special needs, and so forth; but through all this these fundamental requirements of the true education, as placarded before us by Plato or by Milton, must always hold the chief place, and all others must be kept in due and conscious subordination to these.

This very obvious remark calls for repetition, as we are so apt to lose sight of ideals amidst the dust of controversy about details or methods or practical needs.

How, then, does our English education stand when thus considered? And what signs are there in our life of our having fallen short or fallen behind, or missed the best that was possible in our circumstances?

It may, I venture to think, be fairly said that to a reflective observer various things are patent which seem to make it expedient that the subject of education should have its place in the proceedings of a scientific association like this, although there may be difference of opinion as to how it should be handled there.

In saying this I have to admit that some educational reformers seem to have doubts as to the propriety of its inclusion in your programme.

The element of personality is so preeminently vital in all education that some men say it cannot be treated as wholly scientific in the ordinary sense, and that there is serious risk in subjecting it too rigidly to the methods of investigation which naturally hold the field in the main departments of this Association, and that men who are wholly accustomed to such methods are not the best equipped for dealing with the problems involved in the education of the young.

If I endeavour in a few paragraphs to express what, so far as I understand it, is the ground of this fear in the minds of some thoughtful objectors, I trust I may not be thought to be wasting your time.

This Section is still in its swaddling-clothes. It has to justify its existence in the coming years. It is therefore of moment that it should be started on its course of early growth as free as may be from prejudice and with the sympathy and support of all who, whatever be their views as humanists or realists, as men of letters or men of science, as teachers of religion or men of practical affairs, desire to see the education of the young in our country advancing and expanding on the best lines.

On this account the misgivings or warnings of every thoughtful critic deserve our attention and may be helpful.

In what I am saying it will be understood, I hope, that I am not expressing views of my own, but endeavouring to act as the recording instrument, a very inadequate and old-fashioned instrument, of views which come to me from one quarter and another.

The inclusion of the study of education by the British Association for the Advancement of Science among its subjects of investigation is, they say, not altogether free from risk.

If you treat education too exclusively according to the analytic naturalistic methods of scientific men you incur the danger of unfitting teachers for the best part of their work, which depends on the inspiring influence of personal ideals breathing through all their lessons, on a vivid sense of the subtle element of personality in the pupil, and on their responsible exercise of the power of their own personality.

In giving the scientifically educated teacher the analytic knowledge of the dissecting chamber you may possibly rob him of the magnetic power of personal sympathy and influence. In this sense, at all events, you must not dehumanise him. The most eminent psychologists, the critics tell us, are beginning to recognise the danger, and they bid the educator beware of science which has a great deal to say about mental processes but takes too little account of the emotions and the will, and seems inclined to forget that men are personalities and not plants or trees or machines and that boys will be boys.

The combination of a living and fruitful experience, these critics assert, with systematic organised scientific methods and processes is more difficult in education than in any other realm of knowledge, because the data are so complicated and so subtle and elusive.

Hence, they say to me quite frankly, the risk of failure to do much that will be of real value in your Educational Section.

In particular I have the impression that they set no great store by presidential addresses, although the address to which you are now listening has at least one merit, that it has no claim to be technically scientific, but is wholly based, so far as any positive conclusions or recommendations are concerned, on practical personal observation and experience.

This section, say the critics, will do its best work by seeking first of all to determine and to set forth :—

(1) What field is to be covered when education is to be treated as a scientific study, and what are the limits of the field, taking care to give due regard to right ideals of moral and social progress as a primary part of the whole.

(2) What methods of investigation are appropriate and what are inappropriate to the study of education.

Such are some of the warnings with which we are asked to begin our discussions. The critics ask the men of science to remember that they are leaving their accustomed field of purely natural phenomena, and entering a field of investi-

gation which is largely, if not mainly, social, political, religious, moral, and lends itself only in a limited degree to those problems which men whose sphere is natural science are more accustomed to handle.

These are some of the criticisms which, as men of science, you have to meet, and I may safely leave them to your tender mercies.

For myself my attitude in the whole matter must of necessity be a humble one. For many years of my life I was a teacher, but entirely untrained, or rather self-taught, that is to say, relying for my instruction and guidance entirely on my own reading, observation, experience, and practice.

I belong to the pre-scientific age of Englishmen engaged in education. I grew up to my profession anyhow, like so many others; and now for some years I have ceased even to teach, and so even as an untrained teacher I am out of date.

It is due to this audience and to my subject that I should say thus much. It is my appeal for your kind indulgence.

As regards the critics whose views I have endeavoured to express, I may say at once that I do not go with them, because I am profoundly convinced that our English education needs the influence of more light and more thought from every quarter, and especially from those who are familiar with scientific methods. "Blessed are they that sow beside all waters."

Moreover, I hail the application of scientific intelligence and scientific methods to this subject, because, looking back, I am profoundly conscious that I should have done my own educational work far less imperfectly if in my youth I had undergone any rational scientific illuminating preparation for it.

In such a process I should have lost no personal gift or aptitude that I possessed, and I should have gained some early knowledge and confidence and power which would have saved me much discomfort and anxiety and some mistakes and failures, and would have saved my pupils some loss and possibly some distress.

When I turn with these thoughts in my mind and look out over the field of English life I see very strong and valid reasons why our education, its merits, its defects, its methods and results, should be seriously considered here, as also in very different assemblies elsewhere.

Above all, the persistently traditional and unscientific spirit that still pervades so much of it from top to bottom, its lack of reasoned reflection, demands our special attention.

"The want of the idea of science, that is of systematic knowledge," said Matthew Arnold, "is, as I have said again and again, the capital want at this moment of English education and English life. Our civil organisation (including our education) still remains what time and chance have made it."

This was written about thirty-six years ago, and it is, to say the least, a surprising thing that in an age of unusually rapid scientific development it should be, in the main, still so true, as it undoubtedly is, of a great part of our English educational system.

There is the lack of any systematic preparation for the business of teaching which still prevails throughout our middle and upper-class education, although here in Cambridge and in Oxford some excellent pioneer work is being done in the training of teachers.

There is the general lack of interest in education which is still so noticeable in a great deal of English society of all grades, the spirit of indifference to it, and even the tendency to depreciate the intellectual life.

There is the excessive influence of tradition and routine on our great schools and universities, and in some quarters an inert or suspicious conservatism.

There is throughout our middle-class education a state bordering on chaos, a country largely unexplored, a mixture of things good and bad, involving a vast amount of wasted opportunity and undeveloped faculty.

Even in elementary education, which has received the largest share of public attention, there is much that needs to be done in a more thoughtful and scientific spirit.

Party politics have to be eliminated as far as possible, especially ecclesiastical politics.

The fitness of a great deal of the teaching to the special needs and requirements of the children has to be considered afresh.

The tendency to overlook the interests and the attainments of each individual child has to be checked.

The wastefulness of our absurdly truncated system of elementary education stopping abruptly at about twelve years of age and then leaving the children to drift away into an unexplored educational wilderness has to be superseded by some rational system of continuation classes made obligatory. Truly the harvest is a plenteous one for those who desire to uplift our English life by helping forward the best modes of educating the rising generation in a scientific, or, in other words, a wise, intelligent, and large-minded spirit.

Much, it is true, has been done in almost every part of the educational field during the last half-century, but not nearly so much as ardent friends of education anticipated forty years ago.

I have already quoted some significant words from Mr. Arnold's illuminating Report on the Schools and Universities of the Continent as he saw them thirty-seven years ago. If that report had been turned to immediate practical account at the time, if some English statesman, like William von Humboldt, had been enabled with a free hand to take up and give effect to Mr. Arnold's chief suggestions, as Humboldt and his colleagues gave effect to their ideas in Prussia in the years 1808 onwards, the advantage to our country to-day would have been incalculable.

In our insular disregard or depreciation of intellectual and scientific forces actually working in other countries, we have undoubtedly wasted some of that time and tide in human affairs which do not wait for either men or nations.

But, putting regrets aside and turning to some of the practical problems that seem to confront us to-day, I venture to put before you for consideration such cursory and unsystematic observations or suggestions as my personal experience has led me to believe to be of practical importance. For more than this I have no qualification.

In the first place, the growth of crowded city populations and the conditions under which multitudes have for at least two generations been growing up and passing their lives in our great cities have set us face to face with the very serious preliminary problem of physical health.

If our physical manhood decays all else is endangered, so that the first business of the educator is to look well to the conditions of a healthy life from infancy upwards.

Hence the great educational importance of the petition presented by 14,718 medical practitioners, including the heads of the profession, to the central educational authorities of the United Kingdom.

This petition opens with these impressive words:—

"Having constantly before us the serious physical and moral conditions of degeneracy and disease resulting from the neglect and infraction of the elementary laws of hygiene, we venture to urge the Central Educational Authorities of the United Kingdom (the Board of Education of England and Wales, the Scotch Education Department, the Commissioners of National Education in Ireland and the Intermediate Education Board of Ireland) to consider whether it would not be possible to include in the curricula of the Public Elementary Schools, and to encourage in the Secondary Schools, such teaching as may, without developing any tendency to dwell on what is unwholesome, lead all the children to appreciate at their true value heathful bodily conditions as regards cleanliness, pure air, food, drink, &c. In making this request we are well aware that at the present time pupils may receive teaching on the laws of health, by means of subjects almost invariably placed upon the Optional Code. By this method effective instruction is given to a small proportion of the pupils only. This does not appear to us to be adequate. We believe that it should be *compulsory* and be given at a much earlier age than at present."

And it concludes as follows:—

"In many English-speaking countries, definite attempts are being made to train the rising generation to appreciate from childhood the nature of those influences which injure physical and mental health. Having regard to the fact that much of the degeneracy, disease, and accident with which medical men are called upon to deal is directly or indirectly due to the use of alcohol, and that a widespread ignorance

prevails concerning not only the nature and properties of this substance but also its effects on the body and the mind, we would urge the Board of Education of England and Wales, the Scotch Education Department and the Irish Education Authorities to include in the simple hygienic teaching which we desire, elementary instruction at an early age on the nature and effects of alcohol. We gladly recognise (1) the value of the teaching on this subject given in some schools in Ireland and in a proportion of the schools of Great Britain, by means of reading primers, moral-instruction talks, &c., and (2) the excellence of the occasional temperance lessons provided in certain schools by voluntary organisations: but until the four Central Educational Authorities of the United Kingdom include this subject as part of the system of National Education, it appears to us that the mass of the pupils must fail as at present to receive that systematic teaching of hygiene and of the nature and effects of alcohol, which alone we consider adequate to meet the national need. Finally, we would venture to urge the necessity of ensuring that the training of all teachers shall include adequate instruction in these subjects."

This petition, coming, as it does, with all the weight of the medical profession, as the expression of their experience and convictions, is, to my mind, one of the most important educational documents which have been published in our time, and it can hardly be disregarded without incurring the charge of folly.

It may be worth while to set it for a moment side by side with the fashionable cult of athleticism, as bringing into relief our curiously unscientific inconsistency in such matters.

On the one hand, in our absent-minded way, we have allowed these generations of town-dwellers, to say nothing of rural villagers, to grow up and live under insanitary conditions which inevitably produce a physically degenerate, enfeebled, and neurotic race of men and women.

On the other hand, in the upper and middle classes, we have been sedulously cultivating the taste for physical exercises, outdoor life, athletics, and sport, thinking nothing of such importance as the development of the body, admiring nothing so much as bodily prowess; carrying all this to such an extent that a natural and wholesome use of athletic exercise has been fostered into a sort of fashionable athleticism, with all its parasitic professionalism, possessing both soul and body.

And the result has been curiously significant; at one end of the scale neglect of the rudiments of sanitation, the loss of the *corpus sanum*, at the other end the idol worship of athleticism, the depreciation of the intellectual life, and the loss of the *mens sana*.

Are we not then in some danger of drifting into the ways of the Greeks, not in their best days but in their decadence, and of the Romans under the demoralising influences of the Empire?

The Greeks, as we are constantly reminded, in the great period of their creative influence, found nothing so absorbing as the things of the mind; a preeminent characteristic of their life was their love of knowledge, their fine curiosity, their enjoyment of the things of the imagination and of thought. It has been noted that what specially conciliated an Athenian voter was the gift of a theatre ticket; and this is a very instructive and significant fact when we bear in mind that the theatre was the great teacher of religion, morals, poetry, patriotism, all in one; that it combined the influences of Westminster Abbey, the plays of Shakespeare, and the heroic achievements of the race; whereas to an ordinary English voter these things are too often only as caviare to the general.

If so, our education has before it the task of doing what can be done to alter this; and from the Greeks we may derive both lessons and warnings. It was in the days when this decadence was beginning that their excessive admiration of the professional athlete, what we might call their athletic craze, called forth the bitter jibes of Euripides, and his impressive warnings and exhortations to admire and to crown with their highest honours, not those who happened to be swiftest of foot or strongest in the wrestling bout, but the man of sound mind, wise and just, who does most to guide others in the more excellent ways, and to uplift the life of his community:

ὅστις ἡγεῖται πόλει
κάλλιστα, σώφρων καὶ δίκαιος ὢν ἀνήρ.

Here we have a warning by no means inappropriate to our own life and its tendencies. It is, indeed, high time to bring serious and, let us say, scientific thought to bear upon the whole matter.

As I look with such thoughts in my mind over those portions of the educational field with which I have been personally familiar, I note various things which seem to call for both consideration and action.

Taking first the elementary school, it is to be noted that our system does too little to draw out and stimulate the faculties or to form the tastes of each individual child.

Classes are still in many cases far too large.

The system of block grants, being inadequately safeguarded or supplemented by inducements to individual children to apply and prepare for certificates of merit or proficiency, however attractive it may be to inspectors and teachers, needs to be very carefully watched in the interests of individual children. The individual child requires the hope and stimulus of some personal recognition or distinction, if its faculties are to be fully roused and its tastes properly cultivated.

Moreover, the aid of scientific thought and experience is needed to bring both the subjects and methods of instruction into closer and more vital relationship with the environment of the children and with their practical requirements, and more weight has to be given to specific ethical teaching, that moral and spiritual training day by day, which has for its end the development and strengthening of character, and taste, and issues in conduct, which is the greater part of life.

And seeing that it is of the essence of any rational or scientific system to avoid needless waste, it is time that our elementary education should no longer be left in its absurdly truncated condition, which allows a child's education to be stopped abruptly and finally at or about the age of twelve, when in the nature of things it should be only beginning. As things are at present, just when the parent of the upper classes is anxiously considering what school will be the best for his son, a vast number of the children of the poorer classes are left by the State to drift out into a wilderness where all things are forgotten.

In this connection, however, it is due to the Board of Education that we take note of the reminders lately issued in the Introduction to the New Code and the memorandum prefixed to the Regulations for the Training of Teachers.

This Introduction to the Code reminds every parent, school-manager, and teacher, very emphatically, that the purpose of the school is to form and strengthen the character and to develop the intelligence of the children, to fit them both practically and intellectually for the work of life, to send them forth with good and healthy tastes and the desire to know, with habits of observation and clear reasoning, with a living interest in great deeds and great men, and some familiarity with, at all events, some portion of the literature and history of their country; and this being so, the special charge and duty of their teachers is by the spirit of their discipline and of their teaching, by their personal example and influence, to foster in the children, as they grow up in their hands, habits of industry, self-control, endurance, perseverance, courage, to teach them reverence for things and persons good or great, to inspire them with love of duty, love of purity, love of justice and of truth, unselfishness, generosity, public spirit, and so not merely to reach their full development as individuals, but also to become upright and useful members of the community in which they live and worthy sons and daughters of the community to which they belong.

Hardly less valuable, as a contribution to education which shall be more thoughtful than hitherto, is the memorandum prefixed to the new Regulations for the Training of Teachers.

I confine myself to one significant quotation from this valuable document:

"Much of the instruction which is given in all subjects must necessarily be founded upon the statements and the experience of other persons; but every education which deserves to be called complete must include some training of the student in those systematic methods of inquiry which are necessary for any assured advance in knowledge, and which are the most truly educative of all mental processes.

"If this scientific spirit is to find its right expression in

the teaching given in elementary schools it must be made to imbue the whole study of the intending teacher during his course in the Training College. It must not be confined to any one branch of the curriculum. It is true that, partly as the result of tradition and partly from other reasons, the term 'scientific method' has come to be associated more particularly with the study of natural phenomena. But as a matter of fact, scientific method is of equal importance, and is indeed of ancient application, in the fields of history, literature, language, and philosophy; and wherever knowledge of these has made advance, it may be discerned that the essential processes of scientific inquiry have been employed. When Matthew Arnold declared in 1868 that the want of the idea of science, of systematic knowledge, was the capital want of English education and of English life, he was thinking of science as a method and not as a prescribed portion or subject of a curriculum. It cannot be doubted that this want has been seriously prevalent in a large portion of the education and training hitherto provided for elementary school teachers."

We might, indeed, widen the scope of these observations and say that this want of regard for scientific method has been and is a prevalent want in almost every department and grade of English education.

These unaccustomed utterances from Whitehall may very well prove memorable in the history of English education, as the words of William von Humboldt, quoted by Matthew Arnold, are so memorable in connection with the education of Germany: "The thing is *not* to let the schools and universities go on in a drowsy and impotent routine; the thing is to raise the culture of the nation ever higher and higher by their means."

Passing from the sphere of the elementary schools to that of secondary education, we enter on a sphere in which there is much greater need of careful study and the guidance of those who know.

Our secondary education has by the Act of 1902 been handed over very largely to county councils, excellent but heterogeneous bodies, and for the most part not only ignorant of educational needs, methods, and possibilities, but quite unaccustomed to their practical consideration—altogether unprepared and untrained for the responsible work now thrown upon them, and hampered by their besetting fear of the ratepayers.

Add to these difficulties the prejudice, so common in the ordinary English mind, against what is known as the "expert," that is, the man who knows from experience, and is therefore likely to be earnest for improvement, and to believe that wise educational expenditure will repay itself, and you see how manifold are the obstacles in the way of immediate progress.

These county authorities need first of all to be themselves instructed and persuaded as to the right subjects for their schools, the coordination or proportion of subjects in any scheme to be encouraged, the methods of instruction, the sort of teachers to be appointed, the wisdom of spending public money on good education, as exemplified in other countries, like Germany, Switzerland, the United States, Denmark.

Our local authorities feel and recognise that something is needed, but very often they seem to be like children crying in the dark. From lack of educational knowledge and educational experience they do not always know the difference between the right and the wrong method, or between the good and the bad school.

In our rural districts at all events it may be said further that one of our first needs is to persuade the local authorities by some convincing proof that expenditure on popular education higher than elementary is a wise economy, and that their bread cast on educational waters will come back to them, not after many days, but very soon and in their own homes. Thus my observation has led me to the conclusion that by way of preliminary to progress our new educational authorities need instruction or persuasion as to the importance of a sufficient provision for really good secondary education; and it would greatly expedite progress if the Government could and would offer more liberal secondary education grants to be earned by efficient schools, and initial grants towards buildings and scientific equipment, to be met by contributions from local rates or other local sources, public or private.

Many persons and localities would be ready to tax themselves with the view of securing a Treasury grant not available without such taxation. Meanwhile the wheels of our local educational chariots are tarrying on every side so far as higher education, whether general or technical, is concerned.

It would also stimulate our local educational authorities if they could be more fully informed as to the practical advantages which have been derived from a practical system of popular education in such a country as the United States of America; and still more if they had set plainly before them the wonderful results derived by a poor country like Denmark during the last twenty-five years, and in the face of every disadvantage, from the system of education initiated by Bishop Grundtvig and taken up by the Government.

And the need of our middle classes, especially that of the farmer and tradesmen classes, is very pressing. A great deal of the education they receive is given in schools of which the public know very little, whether as regards qualifications of the staff—moral and intellectual—equipment, or methods of teaching, or even sanitary arrangements; and it is to be feared that much of this education would on inquiry be found to be very poor, if judged by any reasonable standard of modern requirements.

When we pass to the class of schools generally spoken of as public schools, those that look to the ancient Universities as the goal of their best pupils, we enter on another very interesting and important field of study.

But for the beginning of our investigation we have to go behind these schools to the preparatory school, which has now assumed a definite place in secondary education, and therefore calls for serious attention. Some of these schools are very good, so far as the conditions under which they work admit of excellence; in others there is, it is to be feared, much room for improvement.

And such schools are now so largely used by parents that their condition becomes a matter of vital importance, as a boy's progress and prospects, his moral and intellectual future, are very frequently determined for good or ill by his experience in the preparatory school, by the bent which has there been given to his morals, tastes, ambitions, by the fostering of his intellectual gifts or the failure to foster them.

In the course of my own experience I have known many boys whose prospects in life were spoilt by their unhappy beginnings in some preparatory school, and who consequently entered their public school foredoomed to failure.

These schools are in most cases private-adventure schools, conducted for private gain. Their staff consists very often of young men untrained for the work of education, and sometimes underpaid. They are subject to no public inspection or examination; in fact, the general public have no knowledge of their condition.

Seeing how grave are the considerations involved, I hold it to be one of the things needed for the general improvement of our secondary education that every private school, of whatever kind, should be liable to public inspection and public report thereon; that a licence should be required for every such school; and that the staff and their qualifications, and the remuneration given to each of them, the sanitary condition, suitability, and educational equipment of the premises, should all be considered in connection with the giving or withholding of a licence.

As regards the curriculum of the schools preparatory to the public schools, the subjects taught, and the proportion of time allotted to each, it has to be borne in mind that they are not free agents. In this respect they are dependent on the requirements of the entrance examination at the public schools which they supply; just as those schools in their turn are dependent on the requirements of the university to which they send their pupils.

Thus, when we come to confer with the authorities of the public schools our first inquiry is whether their entrance examination is such as to conduce to the best system of education from infancy upwards.

Believing, as I do, that there is room for improvement, I would ask them to consider and come to a general agreement as to the subjects on which special stress should be laid. What place, for instance, is occupied in the Eton entrance examination by such subjects as English language and literature, English composition, spelling, handwriting,

and reading aloud? What weight is given to elementary drawing, or to an elementary knowledge of natural phenomena, so as to encourage in the preparatory school an interest in the mineral, vegetable, and animal world around us, and to stimulate in early years the habit of observation, and to impress the difference between eyes and no eyes?

Such subjects as these, it is now generally recognised, ought to be given a foremost place and equal weight with the modicum of arithmetic, French, and ancient languages, which have hitherto, as a rule, formed the staple of this entrance examination, and have consequently given an unnatural twist to the earlier education of our boys.

As regards the public schools themselves, if we consider them critically—though, on the other hand, I trust, by no means forgetting their many and great excellences—the points that invite attention would seem to be such as the following :—

There is undoubtedly a great deal of waste in these schools owing to the poor teaching of untrained masters, who in some cases cannot even maintain reasonable discipline, and in many more have no real knowledge or mastery of the best methods of teaching their subject, be it linguistic, or historical, or literary, or scientific, and have not acquired that first gift of an efficient teacher, the art of interesting their pupils and drawing out their faculties and their tastes.

It would, therefore, be reasonable, as it would certainly be stimulative and advantageous, to require that all masters should be bound to go through some system of well-considered and serious preparation or training for the teacher's work, or at the least a probationary period.

It should, I venture to think, be made a rule that no master could be placed on the *permanent staff* until he was certified and registered as having fully satisfied this requirement and given proof of his efficiency.

And here I would venture to point out to existing masters and mistresses in the leading schools how great a service they may do to the cause of good education if they themselves apply to be registered.

Seeing the advantages which registration is destined to bring to our secondary education by winnowing out inefficient teachers and otherwise, the higher members of the profession may fairly be expected to give their personal adhesion to it as a part of their duty to their profession.

We might almost say to them *noblesse oblige*.

Again, it must, I fear, be admitted that one of the chief defects in our public school education is still to be found in over-attention to memory work, and in the comparative failure to develop powers of thought, taste, and interest in the things of the mind.

And even in the teaching of languages attention has been too exclusively devoted to mere questions of grammar, as if to learn the language were an end in itself, whereas, in the words of Matthew Arnold, "the true aim of schools and instruction is to develop the powers of our mind and to give us access to vital knowledge."

For this end, as he reminds us, the philological or grammatical discipline should be more consciously and systematically combined with the matter to which it is ancillary, the end should be kept in view; whereas nine out of ten of our public-school boys seem never to get through the grammatical vestibule at all; and yet we agree that "no preliminary discipline should be pressed at the risk of keeping minds from getting at the main matter, a knowledge of themselves and the world."

This also was written by Mr. Arnold thirty-six years ago, and thoughtful critics are still repeating, and with some reason, that the majority of boys who grow up in our public schools seem hardly to have received an adequate training for many of the higher duties of life.

We hear much more than formerly about the public schools being the best training-place for good citizenship. Therefore, say the critics, it is reasonable to inquire how far their educational system, their ideals, their traditions, their fashions, and the pervading spirit of their life fit the mass of their pupils intellectually and otherwise for the duties of citizenship, and for grappling in the right spirit with the problems that will confront them.

"Any careful observer," says one of these writers, himself a loyal public-school man, and intimately acquainted with school life, "any careful observer, who has studied the political moods and opinions of the middle classes in this country during the past few years, can hardly have failed to notice two obviously decisive influences: an ignorance of modern history and a want of imagination. For both of these defects the public schools must bear their full share of blame.

"It may be doubted whether any other nation teaches even its own history so little and so badly."

The result is that "to the average public school and university man the foreign intelligence in his daily paper is of less interest than the county cricket; and though events of far reaching importance may be happening almost under his eyes he is in the dark as to their significance."

"As regards the duties and aims of citizenship in all the various affairs of his own country, political, social, economic, he goes out from his school almost wholly uninstructed by the lessons of history, or by any study of the life and the needs of our own times. Again, as it is urged, the lack of imagination is hardly less dangerous to us than lack of instruction in the lessons of history and the social conditions and needs amongst which we have to live and work. No doubt the gift of imagination is a natural gift—it cannot be created. But, given the thing in the germ, it can be stimulated and developed, or starved, stunted, or even crushed out. No system of education that neglects it is even safe. For, without it, principle becomes bigotry and zeal persecution. It is conscientiousness divorced from imagination that produces Robespierres. Now, it is precisely here that we should expect the public schools to be most helpful, for it is through literature that the faculty is most obviously cultivated, and they all profess to give something of a literary training. But though the intention is excellent the performance is often terribly meagre." Whatever may be thought of such criticisms as these, which come from within our public-school life, it is, I imagine, generally agreed by those who know both our national needs and the work and influence of our public schools, that there is much room for improvement in regard to methods of teaching, the cultivation of intellectual interests and tastes, and the stimulating habits of thought in the majority of their pupils. In close connection with these considerations there are two questions of practical importance which deserve a prominent place in any study of our public-school education.

The first of these is whether it is good for all boys alike to continue their life at school, especially at a boarding school, up to the age of eighteen or nineteen; and the other is whether more encouragement and pains should not be given to developing the best type of day school, or, to put it somewhat differently, whether the barrack life of the boarding school has not, through fashionable drift and class prejudice, become too predominant a part of our English education at the expense of the home life with all its finer educational influences.

As regards the first of these questions, it will be remembered that Dr. Arnold considered it a matter of vital importance to expedite the growth of a boy from the childish age to that of a man.

In other words, the boy should not be left to grow through the years of critical change from fourteen to nineteen without special regard to his growth in intellectual taste and moral purpose and thoughtfulness. His education during these critical years should be such as to rouse in him the higher ambitions of a responsible manhood.

Does, then, the actual life of a public school really conduce to this early development in the majority of cases?

My own experience has led me to the conclusion that it cannot be confidently held to do so.

The boys in any of our public schools may be said to fall into two classes—those who in due course reach the sixth form, and during their progress through lower forms have an ambition to reach it; and, on the other hand, a numerous class who do not expect to rise to the sixth, don't care about it, and never exert themselves to reach it.

For the first class, I doubt if any more effective preparation for life has been devised than that of our best English schools; but the case of the second class is somewhat different.

Many of these come to the end of their school time with their intellectual faculties and tastes and their sense of responsibility as men to a great extent undeveloped.

From sixteen to eighteen or nineteen their thoughts, interests, and ambitions have been largely centred in their

games and their out-of-school life, with the natural results that their strongest tastes in after life are for amusement and sport.

Some of these boys, after loitering at school to the age of eighteen or nineteen, go to the University as passmen, some begin their preparation for the work of a doctor or a solicitor, and many go straight from school into City life as men of business; and nearly all of them suffer from the lack of intellectual and moral stimulus during these later years of their school life.

Now many of these boys could without difficulty pass the entrance examination to the University at sixteen or seventeen, if well and carefully taught; and I have long held the view that such boys would greatly benefit by going to Oxford or Cambridge at the age of seventeen, or even sixteen, if suitable arrangements could be made.

It was with this conviction in my mind that I published a scheme showing how this experiment might be tried about twenty years ago.

The interval has confirmed me in the opinion that it would be a distinct gain to many boys to take advantage of such a scheme if made available. They would go out into the world from the University at the age of twenty far better equipped and prepared for life, both as regards knowledge and interests, tastes, and character, than by going straight from school at nineteen.

And looking to my own University of Oxford, I see no reason why such younger students should not be safely received.

There are at least three Colleges in that University which would find it easy to adapt their arrangements so as to secure this. Each of these Colleges has a hall in connection with it, well suited for the residence of a college tutor who might have special charge of these younger students, residing in the hall during their first year with somewhat stricter rules as to ordinary discipline and liberty, but in all other respects exactly on a par with the senior undergraduate members of the College.

On the subject of the day school, as compared with the boarding school, a subject which has not hitherto received the attention it deserves, I may venture to repeat here what in substance I have said on other occasions.

Many parents are so situated that they have no choice in the matter; but to the educational inquirer it is a question of much interest and importance.

The boarding school is admitted to excel in turning out strong, self-reliant, sociable, practical men of affairs, men who have learnt by early experience not to think or make too much of small injustices, to rough it, if need be, with equanimity and cheerfulness, and to count it a man's part to endure hardness in a manly spirit. It is a fine type of character which is thus produced, at its best; but the best is not always seen in the result, and the system too often produces an undue deference to public opinion, a spirit of moral compromise, and a loss of moral enthusiasm. The human soul in its finer parts is a very sensitive thing, and I do not think the barrack life of an average boarding school is always the most favourable for its healthy growth.

As I look back over the school days of my own pupils I feel that those of them had, on the whole, the best education who grew up as day boys in good homes at Clifton College. There they enjoyed all the advantages of the cultivated home, which I need not here enumerate, and at the same time, through the arrangements we made for them, all the best elements in the life of a great boarding school.

In the upper school of 500 boys, we had about 160 day boys living at easy distances from the school.

These boys were divided into two houses—North Town and South Town—about eighty boys in each house, and they were treated for school purposes just as if they were living together in a boarding house.

They were under the same rules as boarders in regard to hours of locking up, or the bounds beyond which they might not go without a note from their parents giving express leave.

Their names were printed in a house list, a master was appointed as their tutor, whose duty it was to look to their educational needs and progress, to their reports and conduct, just as if they had been boarders and he their house master. Each house had its own room or library on the College premises, with books of reference, and so forth, for spare hours, and took its part with the boarding houses, and held its own in all school affairs, games, and other competitions. And my experience of this system compared with others has led me to the conclusion that the form of education which may on the whole claim to be the best is that of a well-organised day school, in which it is clearly understood to be the duty of the masters to give their life to the boys in school and out of school, just as if they were at a boarding school, and in which the boys are distributed into houses for school purposes, just as if they were living in a boarding house. Under such a system they get the best of both worlds, home and school.

From the public school we pass naturally to the Universities, and the first question that meets us is the influence they exercise on school education, through their requirements on admission or matriculation and the bestowal of their endowments and other prizes.

On this part of my subject I have seen no reason to alter or modify what I said at Glasgow three years ago, and therefore I merely enumerate and emphasise the suggestions which I put forward on that occasion for the improvement of education both at school and college.

I hold that it would be equivalent to pouring a new stream of intellectual influence through our secondary education if Oxford and Cambridge were to agree on some such requirements as the following:—

(1) In the matriculation examination (*a*) candidates to be free to offer some adequate equivalent in place of Greek.

(*b*) An elementary knowledge of some branch of natural science, and of one modern language to be required of all candidates.

(*c*) A knowledge of some period of English history and literature also to be required of every candidate, and ability to write English to be tested.

(*d*) The examination in Latin and any other foreign language to include questions on the subject-matter of any prepared books offered, some questions on history and literature, and translation of easy passages not previously prepared.

(*e*) Marks of distinction should be given for work of superior merit in any branch of this examination, as, indeed, of every pass examination conducted by the University.

Candidates should not be excluded from residence before passing this examination, nor should they be required to pass in all subjects at the same time; but the completion of this examination would be the necessary preliminary to entry for any other examination required for a degree.

(2) On the question of endowments and the minimising of waste in the administration of them there is much to be said, and I would suggest for consideration:

(1) That, as a rule, open scholarships and exhibitions might be reduced to free tuition, free rooms, and free dinners in hall, or thereabouts.

(2) That every holder of an open scholarship or exhibition, whose circumstances were such that he needed augmentation, should, on application, receive such augmentation as the College authorities considered sufficient.

(3) That care should be taken to discourage premature specialisation at school.

For this end it should be required that no scholar should enjoy the emoluments of his scholarship until he had passed the matriculation examination described above; and a fair proportion of scholarships should be awarded for excellence in a combination of subjects.

The Universities might also do good service in the way of stimulating secondary education, if some small proportion of their entrance scholarships were distributed over the country as county scholarships, on condition that the county contributed an equal amount in every case.

In this way some equivalent for the endowments, so cynically confiscated by the Education Act of 1902, might be recovered and used for the benefit of poor and meritorious students.

Other reforms, which would, as I believe, be productive of valuable results, are the requiring from every candidate for a degree a knowledge of some portion of our own literature and history, and the encouragement of intellectual interests and ambitions by abolishing all purely pass examinations. A pass examination, in which the candidates are invited simply to aim at a minimum of knowledge or attainment, is hardly worthy of a university. The opportunity

of winning some mark of distinction in this or that portion of what is now a pass examination would frequently rouse some latent ambition in an idle man, and transform the whole spirit of his work.

Thus a modest reform of this kind might be of great practical benefit to the nation by helping in its degree to intellectualise the life of a great many of our young men, and draw out unsuspected interests, faculties, and tastes.

My observations have run to such a length that I must, perforce, conclude, leaving untouched other aspects of University education and training, whether in the old or the new universities, as also the whole subject of the higher education of women, and its proper relationship to traditional systems of instruction and study, framed and intended for men.

And my last word is a word of practical inquiry. How is this Section to be made of most value as an instrument of educational progress?

I leave the answer to this question to those more competent to give it, merely putting on record my own feeling that it may do a valuable service and supply one of our special educational needs, if the working committee of the Section, enlarged by the addition of various representative persons, makes it a duty to collect and publish year by year in succession a series of papers, the best that can be written by recognised authorities, on the chief branches of our English education, dwelling on its immediate and pressing needs, and how best to supply them. To do this the Committee should set to work systematically, commencing in October with monthly meetings, and formulating, without delay, the scheme or series of papers to be prepared and presented to the next meeting of the Association.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. H. BURROWS has been appointed to the post of lecturer and demonstrator of chemistry at the Sir John Cass Technical Institute, Aldgate.

A CONFERENCE of delegates appointed by the Welsh county councils to discuss the question of afforestation in the Principality was held at Swansea on September 7. Sir Charles Philipps, who presided, remarked that there was in Wales an enormous area which could be profitably afforested. It was necessary that professors of the subject should be appointed at the universities, and that practical demonstration areas should be set apart. The view was expressed, in course of discussion, that the establishment of a central school of forestry for Wales was of the utmost importance, and that such a school would become self-supporting after a few years. It was at length resolved that the members should urge on their respective councils the great importance of the study and practical application of forestry by providing lectures to be given at suitable centres and bursaries, enabling students to attend these lectures; also that a central school of forestry be established with example plants of three or more acres, and demonstration areas of suitable extent, and that the necessary expense be defrayed by the county councils on the basis of their respective rateable values, the whole amount now asked for not to exceed 5000*l*.

ADDRESSES will be given at most of the medical schools on the occasion of the opening of the winter session early in October. At Charing Cross Hospital, the session will be opened by the delivery of the fifth biennial Huxley lecture, on "Recent Advances in Science and their Bearing on Medicine and Surgery," by Sir William MacEwen, F.R.S. At the St. George's Hospital an introductory address on "Some Landmarks in the History of Medical Education" will be given by Prof. A. Macalister. The opening meeting of the Physical Society of Guy's Hospital will be held on October 8, when Sir Samuel Wilks, F.R.S., will preside. At King's College Hospital Dr. Thomas Buzzard will deliver an address on "The Future Relation of King's College to its Medical School and Hospital." At St. Mary's Hospital the introductory address will be delivered by Prof. A. E. Wright. At the Middlesex Hospital the session will open with an introductory address by Dr. F. J. Wethered. At University College, London, an introductory address will be given by Prof. J. Norman Collie, F.R.S. The introductory address in connection with the opening of the winter session of the London (Royal Free Hospital) School of Medicine for Women will be delivered by Miss Murdoch at the Medical School on October 3. At the Pharmaceutical Society the inaugural sessional address will be delivered by Prof. A. W. Crossley.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 9.—M. Mascart in the chair.—On a gaseous interrupter: K. R. **Johnson.** The interrupter consists of two plates of aluminium placed in a solution of an electrolyte. The heating effect of the current evolves a bubble of steam, which temporarily breaks the circuit; this is rapidly condensed in the upper part of the cell, and so causes a series of makes and breaks. It has the advantage of working independently of the dimensions of the metallic circuit, and even in the absence of an induction coil or a solenoid. Its disadvantage is that the frequency is rather low.—On a reagent for the hydrides of phosphorus, arsenic, and antimony: P. **Lemoult.** These gases, when diluted with an inert gas, react with a solution of the double iodide of mercury and potassium, giving characteristic crystalline precipitates, orange, yellow or brown in colour. They have been analysed, and correspond to the formula RHg_3I_3, in which R may be P, As, or Sb.—Benzopinacone and benzopinacoline: Amand **Valeur.** Evidence is given that the compound obtained by W. Dilthey and E. Last by the interaction of ethyl oxalate and phenylmagnesium bromide is a pinacone and not a pinacoline as supposed by them.—The synthesis of estragol and aromatic derivatives with an unsaturated chain: M. **Tiffeneau.**—On the reproductive apparatus of the Mucorinæ: J. **Dauphin.** Glucose, levulose, and galactose favour the appearance of sporangia; lactose and saccharose give only sporangia and chlamydospores; maltose and mannite give uniquely chlamydospores.—On macles: G. **Friedel.**—The relations between the blood circulation and the measurement of tactile sensibility: N. **Vaschide.** It is shown that there is an extremely close relation between the circulation of the blood and the tactile sensibility.

CONTENTS.